Year 3; 2nd Quarter
Progress Report for Contract

NASW-99002

What is the Relationship between Heavy Ion Outflow and High-Latitude Energetic Particle Precipitation?

Prepared for:

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September, 2001

1. Description of Progress For Year 3, 2nd Quarter

We have made good progress in our study of the relationship between ion outflow fluxes and substorm phase. As we have stated before this involves using FAST/TEAMS measurements from the December 1996 to February 1997 period so that all measurements are made in the same hemisphere and season and over a short enough time interval so that there is little variation in solar activity and instrument sensitivity. We have processed all of the TEAMS data from December, January and half of February. We have the last half of February left to do. When that is finished we will be able to produce our final plots for the paper. Figure 1 shows the spatial coverage of the data we have processed.

The other part of this is identifying the substorms during the three-month interval so that we can list all onset time that occur near the time of a FAST pass. To date we have identified a little over 300 substorms that satisfy the criteria that onset time is within one hour (before or after) the time of a FAST pass.

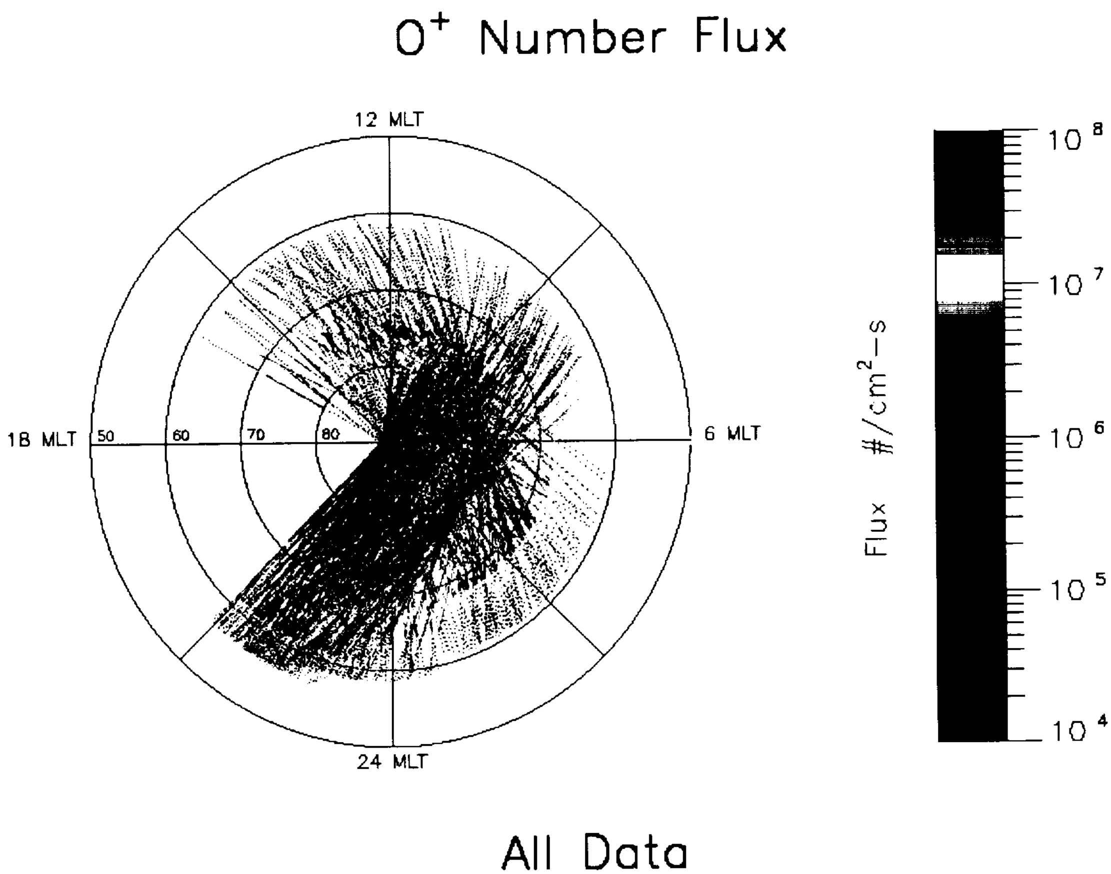

Figure 1. MLT-Invariant Latitude dial plot of high latitude FAST passes from the months of December 1996 to February 1997 that we have processed. Each point along each pass is color code for the intensity of the upgoing O^+ flux measured by TEAMS at that point. We have yet to process the last two weeks of February 1997, which will fill in some of the interval between 1800 and 2100 MLT.

Figures 2 and 3 below show some of our results for average upward fluxes of suprathermal ions in the nightside auroral zone as a function of time from substorm onset. The region over which fluxes were averaged extended from 50° -- 85° invariant latitude and from dusk (1800) to dawn (0600) MLT except where otherwise noted. Three things stand out in these figures:

(1) The increase in the average flux from pre-onset to post onset is larger for pre midnight MLT locations than for post midnight MLT. This is likely due to the development of the westward traveling surge that gives more auroral activity, on average, on the pre rather than post midnight side of the auroral zone.

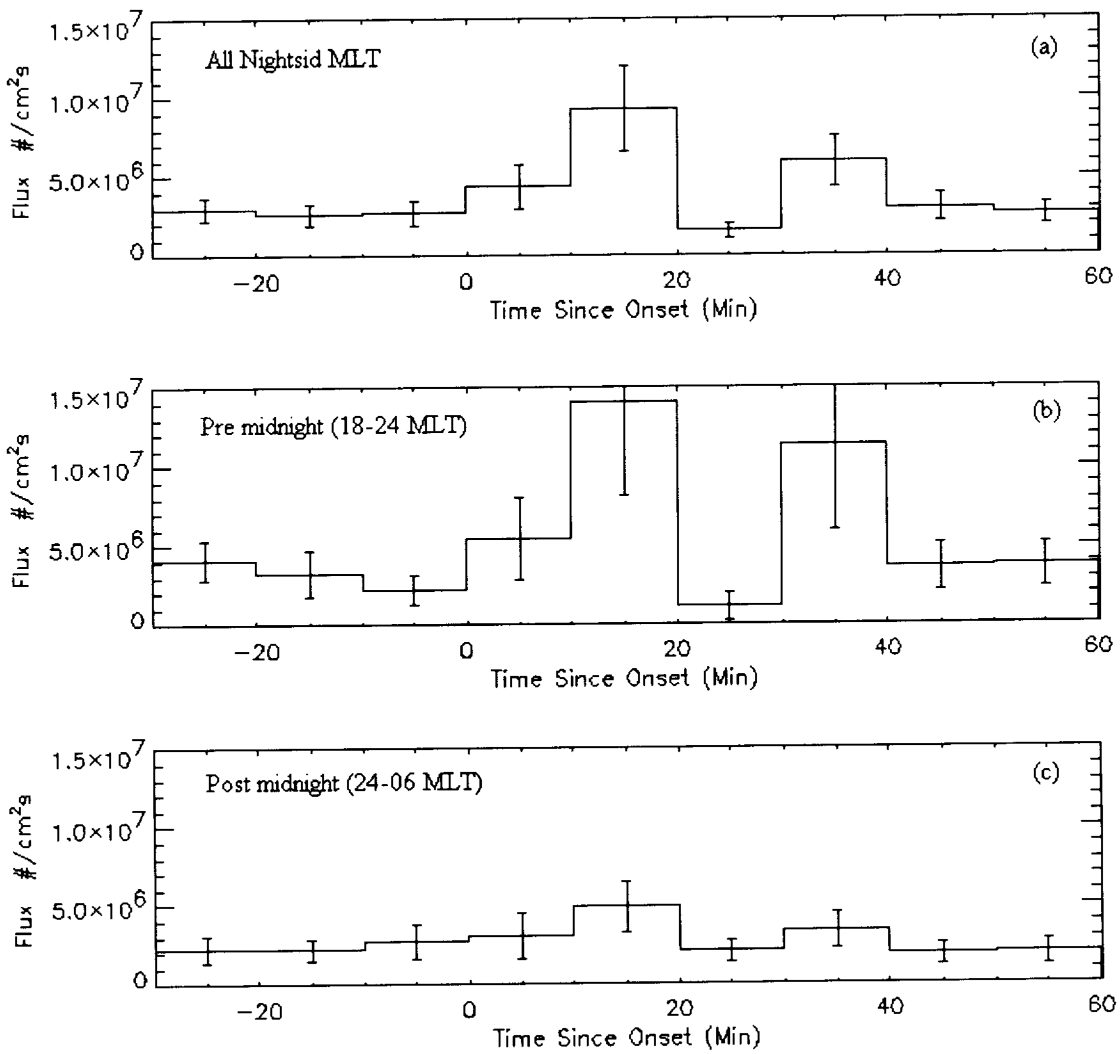

Figure 2. Average H^+ number flux as a function of time from substorm onset for all magnetic substorms in our sample interval and (a) at all nightside MLT, (b) only pre midnight, and (c) only post midnight.

(2) The increase in the average flux occurs about 10-20 minutes after onset, perhaps as a result of the length of time it takes for increased activity to spread over a significant portion of the auroral zone.
(3) After the average flux peaks 10-20 minutes after onset it drops to a value that is lower than what is seen pre onset. We are still working on figuring this one out.

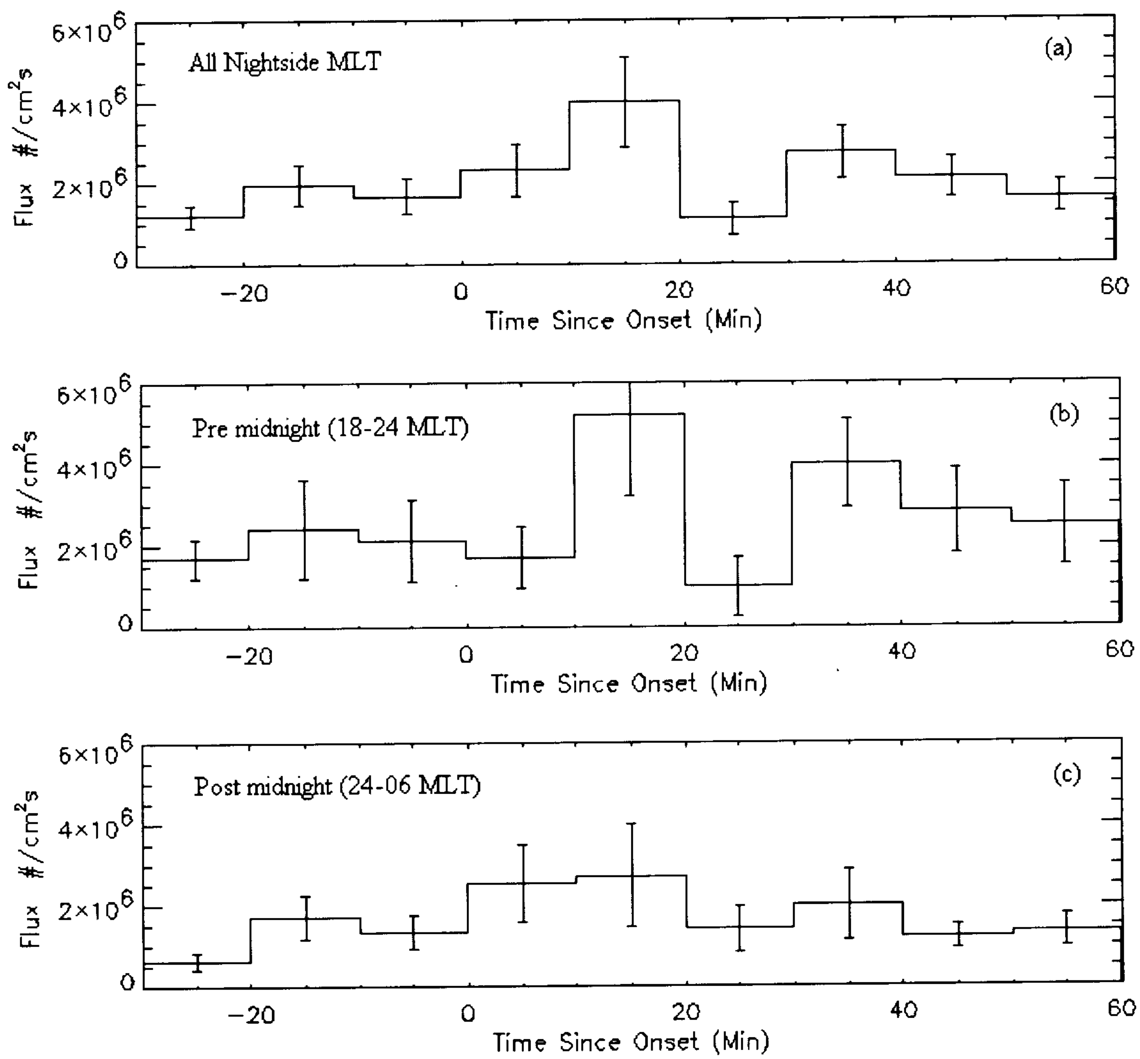

Figure 3. Average O^+ number flux as a function of time from substorm onset for all magnetic substorms in our sample interval and (a) at all nightside MLT, (b) only pre midnight, and (c) only post midnight.

One of the issues that we deal with in doing the sort of data sorting and averaging that is done in this project is how readily we can separate out the effects of different variables. To that end we show in figure 4 the average invariant latitude and MLT of the TEAMS data subsets in each time bins in figures 2 and 3. One can see here that the variations in average flux seen in the previous figures cannot be explained in terms of similar variations in the average latitude or MLT of the data in each bin.

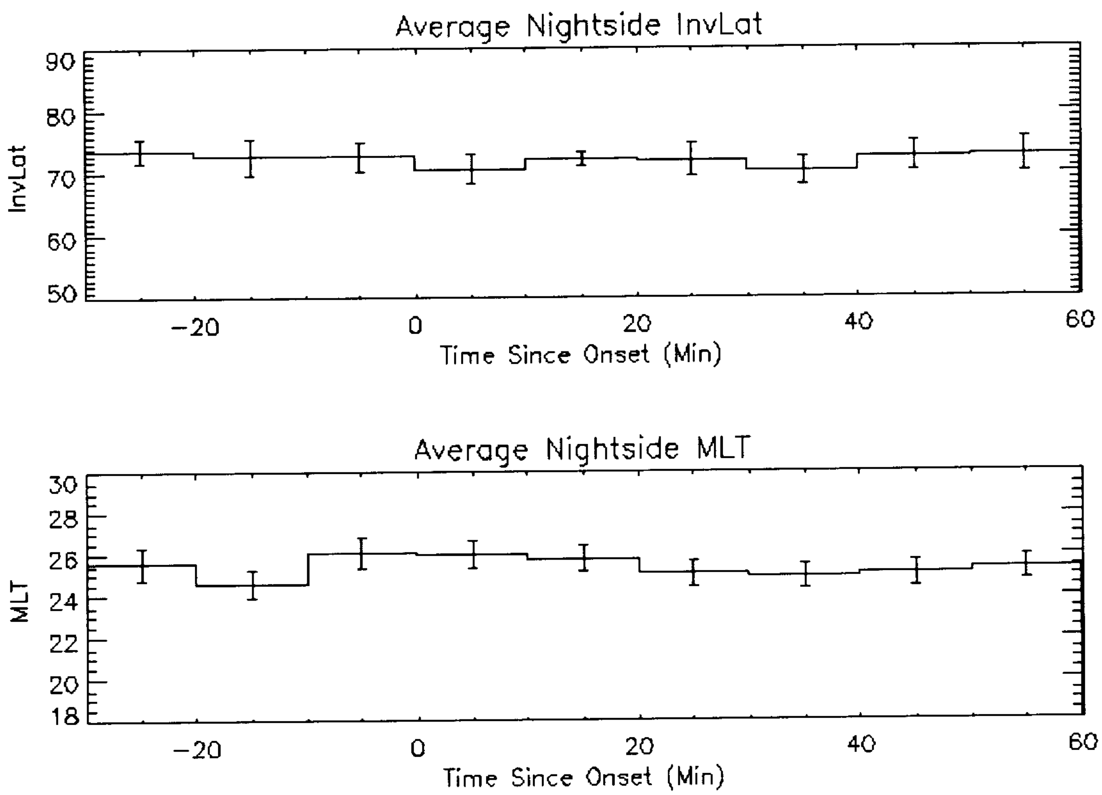

Figure 4. Average invariant latitude and MLT of the FAST/TEAMS data from each of the time bins used in figures 2 and 3.

2. Publications and Presentations

Wilson, G. R., D. M. Ober, G. A. Germany, E. J. Lund, The relationship between suprathermal heavy ion outflow and auroral electron energy deposition: Polar/UVI and FAST/TEAMS observations, *J. Geophys. Res.*, in press, 2001.

Wilson, G. R., D. M. Ober, G. A. Germany, E. J. Lund, The Relationship between Suprathermal Ion Outflow and Auroral Electron Energy Deposition: Polar/UVI and FAST/TEAMS Observations, AGU 2000 Spring Meeting, SM22B-06.

Wilson, G. R., D. M. Ober, Nightside Auroral Zone Outflow as a Function of Substorm Phase, AGU 2001 Spring Meeting, SM42A-09.

3. Current Problems.

At the moment there are no problems hindering the continuation of this project.

4. Work to be performed during the next reporting period.

During the next quarter reporting period (September 4, 2001 – December 3, 2001) we plan to make enough progress on the substorm study to submit a paper on the subject.

5. Cost information.

About 64% of the budget for years 1-3 has been spent.

REPORT DOCUMENTATION PAGE			*Form Approved* *OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
September 4, 2001

3. REPORT TYPE AND DATES COVERED
3rd Year 2nd Quarter Report 4 June '01 - 3 Sept. '01

4. TITLE AND SUBTITLE
The relationship between heavy ion outflow and energetic electron precipitation

5. FUNDING NUMBERS
NASA contract number:
NASW-99002

6. AUTHOR
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER
10

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
National Aeronautics and Space Administration
Goddard Space Flight Center
Headquarters Procurement Office, Code 210.H
Greenbelt, MD 20771

10. SPONSORING/MONITORING AGENCY REF NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
This report can be made freely available to the public.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Second quarter progress report for year 3 on contract NAW-99002 "What is the Relationship between heavy ion outflow and high latitude energetic particle precipitation". In this Project we are studying the relationship between the fluxes, mean energies, and field-aligned flow speeds of escaping suprathermal H^+ and O^+ measured by the TEAMS instrument on FAST and the energy flux of precipitating electrons obtained from the LBHL images taken by the UVI camera on POLAR. In this portion of the project we are using UVI images to tell us when substorm onsets occur and how the auroral zone changes during the course of a substorm. We are correlating this information with TEAMS flux measurements made over the auroral zone at times close to these substorms. The goal is to understand how the flux of suprathermal ion outflow varies with substorm phase.

14. SUBJECT TERMS
Ion Outflow, Particle Precipitation

15. NUMBER OF PAGES
7

16. PRICE CODE

17. SECURITY CLASSIFICATION O REPORT	18. SECURITY CLASSIFICATION O PAGE	19. SECURITY CLASSIFICATION O ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL